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Pawnee Reservoir
Lancaster County, Nebraska

Pacific Northwest Environmental Research Lab, Corvallis, Oreg

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NATIONAL EUTROPHICATION SURVEY

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REPORT
ON
PAWNEE RESERVOIR
LANCASTER COUNTY
NEBRASKA
EPA REGION VII
WORKING PAPER No. 560

WITH THE COOPERATION OF THE
NEBRASKA DEPARTMENT OF ENVIRONMENTAL CONTROL
AND THE
NEBRASKA NATIONAL GUARD
AUGUST, 1976

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Nebraska Department of Environmental Control for professional involvement, to the Nebraska National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

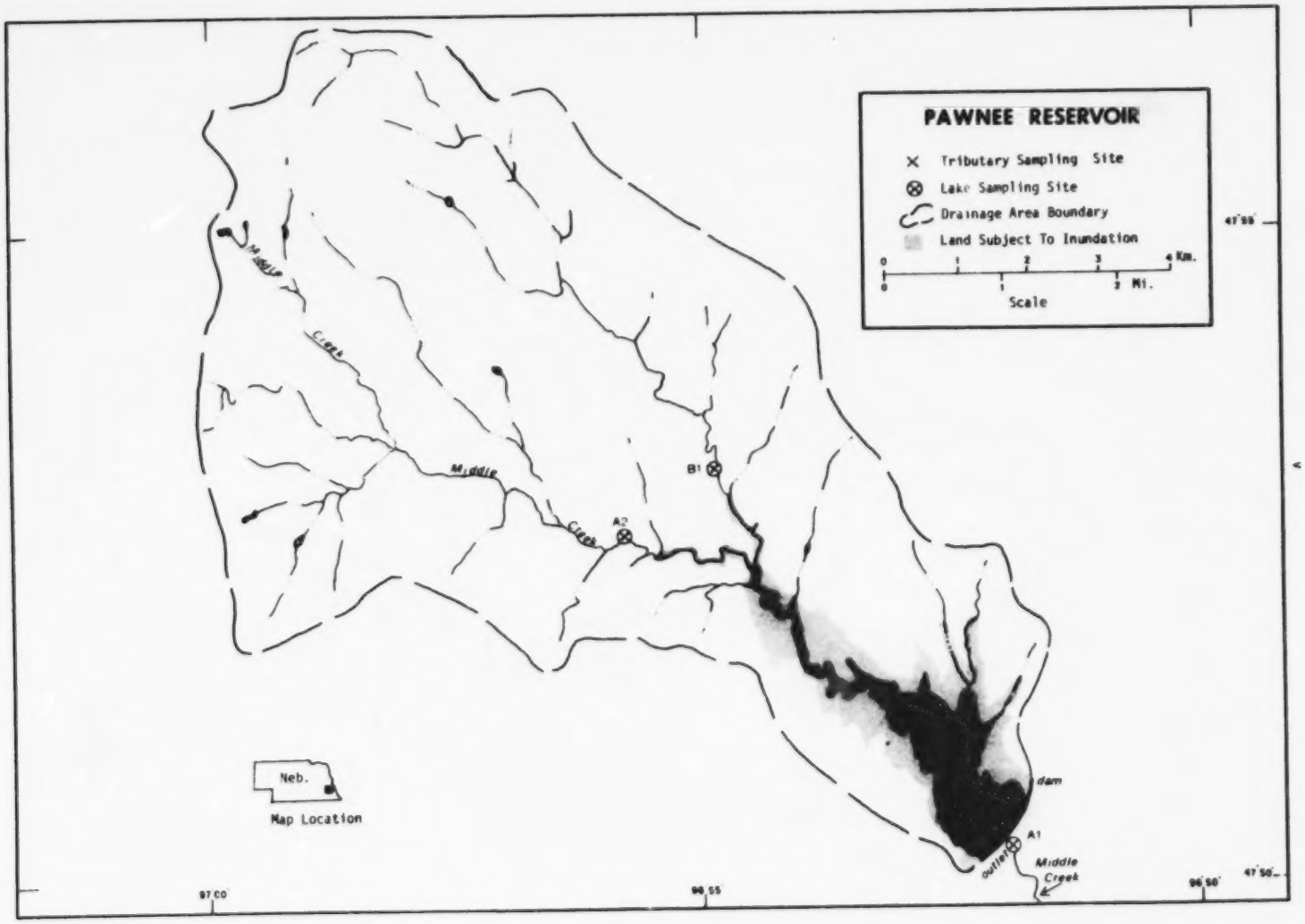
The staff of the Water Pollution Control Division, Department of Environmental Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General Francis L. Winner, the Adjutant General of Nebraska, and Project Officer Colonel Burl M. Johnson, who directed the volunteer efforts of the Nebraska National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STATE OF NEBRASKA

RESERVOIR NAME	COUNTY
Branched Oak	Lancaster
Harlan County	Harlan
Harry D. Strunk	Frontier
Hugh Butler	Frontier, Red Willow
Johnson	Dawson, Gosper
McConaughy	Keith
Pawnee	Lancaster
Sherman	Sherman
Swanson	Hitchcock


PAWNEE RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
Land Subject To Inundation
0 1 2 3 4 Km.
0 1 2 Mi.
Scale
Middle Creek
Middle Creek
B1
A2
A1
dam
outlet
Middle Creek
Neb.
Map Location
97°00'
96°55'
96°50'
47°55'
47°55'

PAWNEE RESERVOIR

STORET NO. 3107

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Pawnee Reservoir is eutrophic. It ranked third in overall trophic quality when the nine Nebraska reservoirs sampled in 1974 were compared using a combination of six parameters*. Two of the reservoirs had less median total phosphorus, six had less median dissolved phosphorus, four had less median inorganic nitrogen and mean chlorophyll a, and two had greater mean Secchi disc transparency.

Survey limnologists did not observe aquatic vegetation or surface concentrations of algae during their three visits to Pawnee Reservoir. However, it is reported that the reservoir has frequent blooms of blue-green algae and extensive areas of rooted aquatic plants (Ketelle and Uttormark, 1971).

B. Rate-Limiting Nutrient:

Because of a change in nutrients in the samples, the algal assay results are not representative of conditions in the reservoir at the times the samples were collected (04/17/74 and 09/26/74).

The reservoir data indicate phosphorus limitation at station 1 in April but nitrogen limitation at station 2. Nitrogen limitation is indicated at both stations in September.

* See Appendix A.

C. Nutrient Controllabiltiy:

1. Point sources--No known point sources impacted Pawnee Reservoir during the sampling year. Nonetheless, the present loading of 0.73 kg $P/m^2/yr$ is three times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11).

2. Non-point sources--The phosphorus contributions of the two gaged tributaries amounted to 71.9% of the total load reaching Pawnee Reservoir during the sampling year. The estimated phosphorus load from the ungaged drainage areas amounted to 25.8% of the total load.

The phosphorus export rates of the two gaged tributaries (see page 10) compare well with those of unimpacted Oak Creek and Middle Oak Creek, tributaries of nearby Branched Oak Reservoir* (26 and 23 kg/km^2yr, respectively).

Because of the lack of point sources and agricultural practices in the watershed (Sheets, 1975), reduction of nutrient inputs is dependent on improved land-use practices in the Pawnee Reservoir drainage (Hergenrader, 1974; Hergenrader and Hammer, 1973; Hammer and Hergenrader, 1974).

* Working Paper No. 554.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 2.99 kilometers^2.
2. Mean depth: 3.7 meters.
3. Maximum depth: 11.0 meters.
4. Volume: 11.063 x 10^6 m^3.
5. Mean hydraulic retention time: 2.9 years (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Middle Creek	37.3	0.10
Unnamed Stream B-1	23.1	0.06
Minor tributaries & immediate drainage -	21.8	0.07
Totals	82.2	0.23

2. Outlet -

Middle Creek	85.2**	0.12

C. Precipitation***:

1. Year of sampling: 60.4 centimeters.
2. Mean annual: 67.7 centimeters.

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† Table of metric conversions--Appendix B.
†† Adamovich, 1975; Hartung, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Pawnee Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at two stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and third visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 7.9 meters at station 1 and 6.1 meters at station 2.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not properly preserved and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR PAWNEE LAKE
STORET CODE 3107

PARAMETER	1ST SAMPLING (4/17/74) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 2/74) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/26/74) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	9.7 - 10.7	10.3	10.3	23.5 - 23.7	23.6	23.6	17.3 - 17.6	17.5	17.5
DISS OXY (MG/L)	10.2 - 10.6	10.4	10.4	6.2 - 7.2	6.7	6.6	7.2 - 9.6	8.4	8.5
CNDCTVY (MCROMO)	336. - 345.	340.	340.	475. - 477.	476.	476.	383. - 385.	384.	384.
PH (STAND UNITS)	------ ----------			7.8 - 8.1	8.0	8.0	7.6 - 7.9	7.8	7.8
TOT ALK (MG/L)	206. - 234.	221.	223.	------ ----------			185. - 276.	227.	220.
TOT P (MG/L)	0.021 - 0.037	0.029	0.029	------ ----------			0.084 - 0.109	0.094	0.092
ORTHO P (MG/L)	0.007 - 0.012	0.009	0.009	------ ----------			0.029 - 0.030	0.030	0.030
NO2+NO3 (MG/L)	0.060 - 0.080	0.067	0.065	------ ----------			0.050 - 0.060	0.057	0.060
AMMONIA (MG/L)	0.060 - 0.080	0.070	0.070	------ ----------			0.130 - 0.290	0.207	0.205
KJEL N (MG/L)	0.700 - 0.800	0.767	0.800	------ ----------			1.200 - 1.400	1.283	1.300
INORG N (MG/L)	0.120 - 0.160	0.137	0.135	------ ----------			0.190 - 0.350	0.263	0.260
TOTAL N (MG/L)	0.760 - 0.880	0.833	0.860	------ ----------			1.250 - 1.460	1.340	1.360
CHLRPYL A (UG/L)	5.7 - 7.2	6.4	6.4	6.0 - 17.7	11.8	11.8	21.1 - 34.5	27.8	27.8
SECCHI (METERS)	1.5 - 2.3	1.9	1.9	0.6 - 0.9	0.8	0.8	0.9 - 0.9	0.9	0.9

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/17/74	1. Dinobryon sp.	849
	2. Cryptomonas sp.	310
	3. Asterionella sp.	212
	4. Stephanodiscus sp.	147
	5. Flagellates	82
	Other genera	97
	Total	1,697
07/02/74	1. Cryptomonas sp.	634
	2. Melosira sp.	465
	3. Flagellates	422
	4. Schroederia sp.	338
	5. Anabaena sp.	296
	Other genera	634
	Total	2,789
09/26/74	1. Melosira sp.	765
	2. Aphanizomenon sp.	382
	3. Microcystis sp.	287
	4. Cryptomonas sp.	271
	5. Stephanodiscus sp.	96
	Other genera	254
	Total	2,055

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/17/74	1	7.2
	2	5.7
07/02/74	1	6.0
	2	17.7
09/26/74	1	21.1
	2	34.5

C. Limiting Nutrient Study:

There was a significant change in nutrients in the assay samples from the times of collection to the beginning of the assays, and the results are not considered representative of the conditions in the reservoir at the times of sampling.

Following is a tabulation of the mean inorganic nitrogen/orthophosphorus ratios for each of the stations and sampling times with the indicated limiting nutrient in parentheses (the July nutrient samples were not preserved properly and were not analyzed).

Station	04/17/74	07/02/74	09/26/74
1	18/1 (P)	-	11/1 (N)
2	12/1 (N)	-	6/1 (N)

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Nebraska National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in August, 1974, and was completed in July, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Nebraska District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in $kg/km^2/year$, at stations A-2 and B-1 and multiplying the means by the ZZ area in km^2.

No known point sources impacted Pawnee Reservoir during the sampling year.

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Middle Creek	975	44.5
Unnamed Stream B-1	600	27.4
b. Minor tributaries & immediate drainage (non-point load) -	565	25.8
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	50	2.3
Total	2,190	100.0

2. Outputs -

Lake outlet - Middle Creek 555

3. Net annual P accumulation - 1,635 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Middle Creek	5,970	35.4
Unnamed Stream B-1	4,035	23.9
b. Minor tributaries & immediate drainage (non-point load) -	3,650	21.6
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	3,230	19.1
Total	16,885	100.0

2. Outputs -

Lake outlet - Middle Creek 5,560

3. Net annual N accumulation - 11,325 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Middle Creek	26	160
Unnamed Stream B-1	26	175

* See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.73	0.55	5.6	3.8

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Pawnee Reservoir:

"Dangerous" (eutrophic loading)	0.24
"Permissible" (oligotrophic loading)	0.12

V. LITERATURE REVIEWED

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Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3101	BRANCHED OAK	0.044	0.070	456.444	17.033	9.400	0.013
3102	HARLAN COUNTY RESERVOIR	0.112	0.365	476.111	27.822	12.200	0.061
3103	HARRY D. STRUNK (MEDICIN	0.064	0.460	470.500	14.367	14.200	0.009
3104	HUGH BUTLER (RED WILLOW)	0.061	0.090	468.875	16.612	14.400	0.014
3105	JOHNSON RESERVOIR	0.075	0.340	477.667	26.133	8.600	0.009
3106	LAKE MCCONAUGHY	0.027	0.585	409.555	8.644	11.400	0.004
3107	PAWNEE LAKE	0.060	0.175	453.000	15.367	8.800	0.020
3108	SHERMAN COUNTY RESERVOIR	0.067	0.090	451.167	6.717	11.800	0.050
3110	SWANSON RESERVOIR	0.067	0.090	466.333	14.450	11.000	0.016

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3101	BRANCHED OAK	88 (7)	100 (8)	63 (5)	25 (2)	75 (6)	63 (5)	414
3102	HARLAN COUNTY RESERVOIR	0 (0)	25 (2)	13 (1)	0 (0)	25 (2)	0 (0)	63
3103	HARRY D. STRUNK (MEDICIN	50 (4)	13 (1)	25 (2)	75 (6)	13 (1)	81 (6)	257
3104	HUGH BUTLER (RED WILLOW)	63 (5)	75 (5)	38 (3)	38 (3)	0 (0)	50 (4)	264
3105	JOHNSON RESERVOIR	13 (1)	38 (3)	0 (0)	13 (1)	100 (8)	81 (6)	245
3106	LAKE MCCONAUGHY	100 (8)	0 (0)	100 (8)	88 (7)	50 (4)	100 (8)	438
3107	PAWNEE LAKE	75 (6)	50 (4)	75 (6)	50 (4)	88 (7)	25 (2)	363
3108	SHERMAN COUNTY RESERVOIR	38 (3)	75 (5)	88 (7)	100 (8)	38 (3)	13 (1)	352
3110	SWANSON RESERVOIR	25 (2)	75 (5)	50 (4)	63 (5)	63 (5)	38 (3)	314

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3106	LAKE MCCONAUGHY	438
2	3101	BRANCHED OAK	414
3	3107	PAWNEE LAKE	363
4	3108	SHERMAN COUNTY RESERVOIR	352
5	3110	SWANSON RESERVOIR	314
6	3104	HUGH BUTLER (RED WILLOW)	264
7	3103	HARRY D. STRUNK (MEDICIN	257
8	3105	JOHNSON RESERVOIR	245
9	3102	HARLAN COUNTY RESERVOIR	63

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEBRASKA 12/23/75

LAKE CODE 3107 PAWNEE LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 85.2

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3107A1	85.2	0.11	0.14	0.23	0.31	0.23	0.15	0.03	0.01	0.01	0.15	0.05	0.05	0.12
3107A2	37.3	0.08	0.09	0.19	0.11	0.16	0.21	0.05	0.04	0.05	0.11	0.06	0.05	0.10
3107U1	23.1	0.05	0.05	0.11	0.07	0.10	0.13	0.03	0.03	0.03	0.07	0.04	0.03	0.06
3107ZZ	24.9	0.05	0.06	0.12	0.07	0.11	0.14	0.03	0.03	0.03	0.07	0.04	0.03	0.07

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 85.2
SUM OF SUB-DRAINAGE AREAS = 85.2

TOTAL FLOW IN = 2.72
TOTAL FLOW OUT = 1.48

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3107A1	8	74	0.0	24	0.00				
	9	74	0.0	21	0.01				
	10	74	0.0	19	0.00				
	11	74	0.0	19	0.00				
	12	74	0.03	7	0.00				
	1	75	0.03						
	2	75	0.11	2	0.05				
	3	75	0.25	15	0.10				
	4	75	0.28	30	0.31				
	5	75	0.17	4	0.25				
	6	75	0.23	7	0.07				
	7	75	0.03	12	0.00				
3107A2	8	74	0.14	24	0.04				
	9	74	0.01	21	0.03				
	10	74	0.06	19	0.03				
	11	74	0.03	19	0.03				
	12	74	0.05	7	0.03				
	1	75	0.06	19	0.03				
	2	75	0.07	2	0.05				
	3	75	0.16	15	0.03				
	4	75	0.15	30	0.09				
	5	75	0.11	4	0.07				
	6	75	0.17	7	0.04				
	7	75	0.05	12	0.04				

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TRIBUTARY FLOW INFORMATION FOR NEBRASKA 12/23/75

LAKE CODE 3107 PAWNEE LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
310781	8	74	0.08	24	0.03				
	9	74	0.01	21	0.03				
	10	74	0.04	19	0.03				
	11	74	0.01	19	0.03				
	12	74	0.03	7	0.03				
	1	75	0.04	19	0.03				
	2	75	0.05	2	0.01				
	3	75	0.10	15	0.06				
	4	75	0.09	30	0.03				
	5	75	0.07	4	0.02				
	6	75	0.11	7	0.03				
	7	75	0.03	12	0.01				
3107ZZ	8	74	0.09	24	0.03				
	9	74	0.01	21	0.02				
	10	74	0.04	19	0.03				
	11	74	0.02	19	0.03				
	12	74	0.03	7	0.03				
	1	75	0.04	19	0.03				
	2	75	0.05	2	0.02				
	3	75	0.11	15	0.04				
	4	75	0.10	30	0.05				
	5	75	0.07	4	0.03				
	6	75	0.12	7	0.03				
	7	75	0.03	12	0.02				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/11/07

310701
40 50 22.0 096 52 02.0
PAWNEE LAKE
31109 NEBRASKA

11EPALES
3

2111202
0022 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/06/17	14 20	0000	10.0		90	337		224	0.000	0.000	0.000	0.010
	14 20	0005	9.9	10.2		338		234	0.000	0.700	0.070	0.009
	14 20	0017	9.7	10.2		336		206	0.000	0.000	0.070	0.007
74/07/02	12 15	0000	23.5	6.2	36	475	7.80					
	12 15	0005	23.5	6.4		475	7.80					
	12 15	0015	23.5	6.4		475	7.90					
	12 15	0026	23.5	6.4		475	8.00					
74/09/26	15 00	0000	17.4	7.2	36	384	7.65	185	0.290	1.300	0.060	0.029
	15 00	0005	17.4	7.8		385	7.66	192	0.280	1.200	0.050	0.030
	15 00	0015	17.3	7.2		384	7.64	191	0.280	1.200	0.050	0.030

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/06/17	14 20	0000	0.032	7.2	
	14 20	0005	0.029		
	14 20	0017	0.028		
74/07/02	12 15	0000		6.0	
	12 15	0007			1.0
74/09/26	15 00	0000	0.084	21.1	
	15 00	0005	0.084		
	15 00	0006			1.0
	15 00	0015	0.085		

STORET RETRIEVAL DATE 75/11/07

310702
40 51 00.0 096 52 32.0
PAWNEE LAKE
31109 NEBRASKA

11EPALES 2111202
3 0022 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/17	14 00	0000	10.7		60	345		222	0.060	0.700	0.060	0.000
	14 00	0005	10.7	10.6		344		224	0.060	0.800	0.060	0.012
	14 00	0017	10.6	10.6		342		218	0.060	0.800	0.060	0.009
74/07/02	11 50	0000	23.7	6.8	24	476	8.10					
	11 50	0005	23.7	7.0		477	8.10					
	11 50	0015	23.7	7.2		476	8.00					
	11 50	0020	23.7	7.0		476	8.00					
74/09/26	14 45	0000	17.6	9.2	36	384	7.90	272	0.130	1.400	0.060	0.029
	14 45	0005	17.6	9.2		383	7.91	276	0.130	1.300	0.060	0.030
	14 45	0010	17.6	9.6		384	7.90	248	0.130	1.300	0.060	0.030

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/17	14 00	0000	0.021	5.7	
	14 00	0005	0.037		
	14 00	0017	0.030		
74/07/02	11 50	0000		17.7	
	11 50	0004			1.0
74/09/26	14 45	0000	0.102	34.5	
	14 45	0005	0.109		
	14 45	0007			1.0
	14 45	0010	0.099		

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APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/01/27

3107A1
40 50 20.0 096 51 52.0
MIDDLE CREEK
31101 7.5 EMERALD
O/PAWNEE LAKE
BANK SAMPLE AT PAWNEE LK DAM SPILLWAY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	15 00		0.004	0.600	0.015	0.120	0.180
74/09/21	10 45		0.024	0.500	0.010	0.105	0.145
74/10/19	14 10		0.024	0.400	0.025	0.115	0.150
74/11/19	10 30		0.048	1.350	0.063	0.072	0.090
74/12/07	14 00		0.010	0.300	0.015	0.125	0.170
75/02/02	09 15		0.375	1.100	0.080	0.030	0.025
75/03/15	11 25		0.064	0.850	0.073	0.015	0.040
75/04/30	14 25		1.300	1.400	0.060	0.190	0.380
75/05/04	10 40		0.005	0.900	0.110	0.005	0.280
75/06/07	10 00		0.005	0.750	0.030	0.010	0.060
75/07/12	15 00		0.060	2.200	0.045	0.040	0.150

92

STORET RETRIEVAL DATE 76/01/27

3107A2
40 52 44.0 096 55 45.0
MIDDLE CREEK
31 7.5 GARLAND
T/PAWNEE LAKE
SEC RD BRDG 9 MI ESE OF SEWARD
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	14 26		1.320	0.400	0.040	0.390	0.390
74/09/21	10 15		1.100	0.800	0.045	0.310	0.380
74/10/19	13 40		0.312	0.900	0.045	0.260	0.320
74/11/19	10 15		0.730	0.500	0.065	0.200	0.240
74/12/07	14 31		0.900	0.500	0.092	0.085	0.250
75/01/19	08 50		1.010	1.000	0.272	0.144	0.180
75/02/02	10 50		1.050	0.600	0.124	0.144	0.260
75/03/15	12 00		0.918	0.750	0.086	0.135	0.250
75/04/30	14 05		0.620	1.830	0.080	0.200	0.350
75/05/04	10 15		0.420	0.900	0.050		
75/06/07	09 30		0.690	1.600	0.330	0.400	0.540
75/07/12	14 22		0.680	1.950	0.067	0.305	0.420

STORET RETRIEVAL DATE 76/01/27

310791
40 53 12.0 096 54 53.0
UNNAMED STREAM
31 7.5 GARLAND
T/PAWNEE LAKE
US HWY 34 BRDG 9 MI E OF SEWARD
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	14 02		0.660	0.400	0.040	0.345	0.345
74/09/21	10 00		0.650	3.200	0.235	0.280	0.460
74/10/19	13 30		0.352	1.900	0.095	0.250	0.440
74/11/19	10 00		0.736	0.900	0.090	0.190	0.220
74/12/07	14 20		0.820	0.900	0.100	0.165	0.290
75/01/19	08 35		0.960	0.900	0.224	0.128	0.170
75/02/02	09 45		1.050	0.400	0.124	0.128	0.190
75/03/15	11 50		0.915	1.200	0.104	0.135	0.240
75/04/30	14 00		0.005	1.600	0.025	0.005K	0.050
75/05/04	10 05		0.810	1.600	0.070	0.200	0.300
75/06/07	09 30		0.820	0.750	0.100	0.320	0.400
75/07/12	14 00		0.600	1.800	0.160	0.340	0.520

K VALUE KNOWN TO BE
LESS THAN INDICATED